a grounding strap to connect said conductive coating of said conductive optical mask to electrical ground;

a field emission electron source to provide an electron beam;

a charged particle beam column to deliver and scan said electron beam from said field emission electron source on a top surface of said conductive coating;

a backscatter electron detector to detect backscattered electrons from said conductive optical mask to generate a backscatter electron waveform as said electron beam scans said conductive optical mask;

a secondary electron detector to detect secondary electrons from said conductive optical mask to generate a secondary electron waveform as said electron beam scans said conductive coating; and

a processor to examine said backscatter electron waveform and said secondary electron waveform to determine construction features of said conductive optical mask.

2. A system to automatically inspect an optical mask as in claim 1 wherein said optical mask is a phase shift mask.

3. A system to automatically inspect an optical mask as in claim 1 wherein said film coating system is a sputtering system.

4. A system to automatically inspect an optical mask as in claim 1 further comprising a memory connected to each of said backscatter electron detector and said secondary electron detector to store said backscatter electron waveform and said secondary electron waveform from said conductive optical mask.

5. A method for automatically inspecting an optical mask, said method comprising the steps of:

a. applying a conductive coating to a top surface of said optical mask to produce a conductive optical mask;

b. electrically grounding said conductive coating;

c. scanning an electron beam on a top surface of said conductive coating of step b.;

d. detecting backscattered electrons from said conductive coating of step c. to form a backscatter electron waveform;

e. detecting secondary electrons from said conductive coating of step c. to form a secondary electron waveform;

f. examining said backscatter electron waveform and said secondary electron waveform from steps d. and e.; and

g. determining construction features of said conductive optical mask in response to step f.

6. A method for automatically inspecting an optical mask as in claim 5 wherein said optical mask is a phase shift mask.

7. A method for automatically inspecting an optical mask as in claim 5 wherein step a further includes the step of:

h. sputtering said coating onto said optical mask.

8. A method for automatically inspecting an optical mask as in claim 5 further including the step of:

i. storing each of said backscatter electron waveform from step d. and said secondary electron waveform from step e.

* * * * *

9. A method of inspecting a substrate, comprising:

a) exposing said substrate to a first group of electrons, said first group of electrons causing said substrate to emit electrons; and

b) exposing said substrate to a second group of electrons, wherein said second group of electrons reduces charging at a surface of said substrate, said charging resulting from said emitted electrons.

10. The method of claim 9, wherein said substrate is a semiconductor wafer.

11. The method of claim 9, wherein said substrate includes an insulating region.

12. The method of claim 9, further comprising detecting said emitted electrons.

13. The method of claim 12, wherein said emitted electrons are secondary electrons.

14. The method of claim 12, wherein said emitted electrons are backscattered electrons.

15. The method of claim 9, wherein said first group of electrons is provided in the form of a beam incident upon said substrate.

16. The method of claim 9, wherein said second group of electrons are electrons from the substrate that are caused to return to the substrate by an electrical field applied to an electrode near the substrate.

17. The method of claim 9, wherein said substrate is maintained at a charge equilibrium condition by the combination of said first group of electrons and said second group of electrons.

18. The method of claim 17 wherein said charge equilibrium condition is set to obtain favorable image statistics.

19. The method of claim 17 wherein said equilibrium condition is affected by localized topographical and material differences on said substrate.

20. The method of claim 17 wherein surface charging creates a potential which maintains said equilibrium condition.

21. The method of claim 9, wherein said charging is substantially caused by a rate of electron emission from said surface that exceeds the rate at which said first group of electrons arrives at said surface.

22. The method of claim 12, further comprising processing signals resulting from said detected electrons.

23. The method of claim 22 wherein said signals are processed by comparison with a reference to detect defects present on said substrate.

24. The method of claim 23 wherein said reference is derived from a corresponding portion of said substrate.

25. The method of claim 23, wherein said reference is derived from a database from which said substrate was designed.

26. The method of claim 9, wherein the first group of electrons has a high landing energy.

27. The method of claim 9, wherein the second group of electrons has a low landing energy.

28. The method of claim 9, wherein the second group of electrons is in the form of a defocused beam.

29. The method of claim 9, wherein the second group of electrons is produced by an intermediate electrode between a source of the electron beam and the substrate.

30. The method of claim 9 wherein the particle beam column is a charged particle beam and includes an aperture member to control a current level and spot size of the electron beam.

31. A system to automatically inspect a substrate, said system comprising:

a electron source to provide an electron beam at least 50nm wide;

a charged particle beam column to deliver and scan said electron beam;

an electron detector to detect electrons from said substrate as said electron beam scans said substrate; and

a processor to examine an image from said detected electrons to determine features of said substrate.

32. The system of claim 31, wherein the electron source provides an electron beam having a width of at least 50nm.

33. The system of claim 32 wherein the electron beam has a width in the range of 50nm - 2000nm.

34. The system of claim 31, wherein the processor further includes:

an image processor to compare images from two different locations on the substrate and determine the location of defects on the substrate when the comparison detects a difference.

35. The system of claim 31 wherein the substrate is a photomask.

36. The system of claim 31 wherein the substrate is a production wafer.

37. A system to automatically inspect a substrate, said system comprising:

a electron source to provide an electron beam from a high brilliance source with an irradiance of greater than 1 milli-amp per steridian;

a charged particle beam column to deliver and scan said electron beam;

an electron detector to detect electrons from said substrate as said electron beam scans said substrate; and

a processor to examine an image from said detected electrons to determine features of said substrate.

38. The system of claim 37, wherein the beam produces an inspection spot on the substrate which is at least 50nm in width.

39. The system of claim 38, wherein the electron source provides an electron beam in the range of 50nm - 2000nm in width.

40. A system to automatically inspect a substrate, said system comprising:

a electron source to provide an electron beam at least 50nm wide;

a charged particle beam column to deliver and scan said electron beam;

an electron detector to detect electrons from said substrate as said electron beam scans said substrate, which is affixed to a stage;

a processor to examine an image from said detected electrons to determine features of said substrate; and

a subsystem to receive feedback about the position of the stage and to correct the position of the electron beam with respect to the stage.

41. The system of claim 40, further comprising an interferometer used to track the position of the stage.

42. A system to automatically inspect a substrate, said system comprising:

a electron source to provide an electron beam;

a charged particle beam column to deliver and scan said electron beam;

an electron detector to detect electrons from said substrate as said electron beam scans said substrate; and

a processor to examine an image from said detected electrons to determine features of said substrate and to compare the image to information from a database, disagreement between the image and the information from the database indicating a defect in the substrate.

43. The system of claim 42, wherein the beam produces an inspection spot on the substrate which is at least 50nm in width.

44. The system of claim 43 wherein the inspection spot is in the range of 50nm to 200nm.

45. The system of claim 42, wherein the database is a CAD database that contains layout information for the pattern of the substrate under test.

46. The system of claim 42 wherein the substrate is a photomask.

47. The system of claim 42 wherein the substrate is a production wafer.

48. The system of claim 42, where the processor includes an alignment processor to measure differences in alignment between a digitized version of the image and the information from the database and then to use the alignment measurement to align the image and the information from the database.

49. A method of automatically inspecting insulated surfaces of a substrate by controlling the build up of surface charge on the substrate, comprising:

a) performing an electron beam inspection of the substrate in multiple swaths, an electron beam dose per swath being selected to control the charge density;

b) performing repeated swaths for a pattern feature of the substrate so as that the resulting multiple feature images are exactly aligned and can be overlaid precisely; and

c) averaging the multiple image features to maximize signal contrast in the image of the pattern feature.

50. The method of claim 49, wherein the performing step includes performing an electron beam inspection of the substrate in multiple swaths, an electron beam dose per swath being selected to minimize the charge density.

51. The method of claim 49, wherein an image of a pattern feature is produced by averaging between 2 to 256 inclusive repeated frames.

52. The method of claim 51, wherein a frame size varies in the range of 512 to 4096 pixels tall by 4 to 4096 pixels wide.

53. The method of claim 49 wherein the substrate is a photomask.

54. The method of claim 49 wherein the substrate is a production wafer.

55. A method of automatically classifying defects in a substrate, said method comprising:

a subsystem to provide a high energy electron beam and a low energy electron beam from a electron source;

a charged particle beam column to deliver and scan said high energy and said low energy electron beams;

an electron detector to detect electrons from said substrate as one of said high energy and said low energy electron beams scans said substrate; and

a processor to examine an image from said detected electrons to determine features of said substrate.

56. A system to automatically inspect a substrate, said system comprising:

a electron source to provide an electron beam;

a charged particle beam column to deliver and scan said electron beam;

a vacuum chamber surrounding the particle beam column and the substrate;

a subsystem for delivering an oxidizing plasma into the vacuum chamber;

an electron detector to detect electrons from said substrate as said electron beam scans said substrate; and

a processor to examine an image from the detected electrons to determine features of said substrate.

57. The system of column 56, wherein the oxidizing plasma is used to clean the particle beam column.

58. The system of column 56 wherein the oxidizing plasma is used to clean the substrate.

59. A method for inspecting insulating and thermally sensitive surfaces of a substrate, comprising:

a) performing an electron beam inspection of the substrate in multiple swaths, an electron beam dose per swath being selected to control thermal load per swath;

b) performing repeated swaths for a pattern region of the substrate so as that the resulting multiple region images are exactly aligned and can be overlaid precisely; and

c) averaging the multiple region images to maximize signal contrast in the image of the substrate.

60. The method of claim 59 wherein the substrate is a photomask.

61. The method of claim 59 wherein the substrate is a production wafer.